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IS 14631 (1999): Styrene - Code of safety [CHD 8: Occupational Safety, Health and Chemical Hazards]

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स्टाइरीन — सुरक्षा संहिता

Indian Standard

STYRENE — CODE OF SAFETY

ICS 13.300

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

January 1999 **Price Group 3**

Chemical Hazards Sectional Committee, CHD 7

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

Styrene monomer is used for the manufacture of polystyrene, copolymers of styrene, synthetic rubber, formulations of protective coatings, ion exchange resins, and other insulating varnishes, various intermediates, etc.

In the preparation of this code, considerable assistance has been derived from the following publications:

i) Styrene — Its Polymers, Copolymers and Derivatives edited by Ray H. Boundy and Raymond F. Boyer published by Reinhold Publishing Corporation, 1952.

ii) Toxic and Hazardous, Industrial Chemicals Safety Manual, published in 1975 by the International Technical Information Institute, Japan.

iii) Environmental Health Criteria No. 26, '**STYRENE**' published under the joint sponsorship of the United Nations Environment Programme, I.L.O. and W.H.O, Geneva, 1983.

iv) Chemical Safety Data Sheet: Styrene Monomer SD -37, published by Manufacturing Chemists Association Inc. USA.

The composition of the committee responsible for formulation of this standard is given in Annex A.

AMENDMENT NO. 1 DECEMBER 2006
TO
IS 14631 : 1999 STYRENE — CODE OF SAFETY

(*Page* 2, *clause* **5.1.1**) — Substitute the following for the existing:

'TLV-TWA : 20 ppm, TLV-STEL : 40 ppm'

(*Page* 4, *clause* **10.2.1**, *title*) — Substitute *'Pre-placement Medical Examination'* for *'Replacement Physical Examination'*.

(CHD 8)

Reprography Unit, BIS, New Delhi, India

Indian Standard

STYRENE — CODE OF SAFETY

1 SCOPE

This standard describes the properties of styrene, the nature of hazards associated with it; essential information on personal protective equipment; storage, handling, labelling and transport; spillage/leakage and waste disposal; fire prevention and fire fighting; training, health monitoring and first aid.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1260 (Part 1) : 1973	Pictorial marking for handling and labelling of goods: Part 1 Dangerous goods *(first revision)*
4105 : 1988	Styrene (vinyl benzene) *(first revision)*
4155 : 1966	Glossary of terms relating to chemical and radiation hazards and hazardous chemicals

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 4155 shall apply.

4 GENERAL PROPERTIES

4.1 General Information

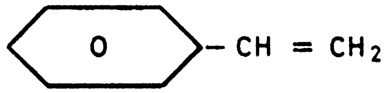
Styrene monomer is a colourless, highly refractive, oily liquid with penetrating odour. It readily undergoes polymerisation when heated or exposed to light or with a peroxide catalyst. The polymerisation reaction is exothermic. The process is autocatalytic and temperature rise accelerates the rate of polymerisation which in turn increases the rate of heat of evolution. Eventually the reaction may become explosive. It is sparingly soluble in water, soluble in alcohol, ether, methanol, acetone and carbon disulphide.

4.1.1 *Common Name:* Styrene Monomer.

4.1.2 *Chemical Names:* Styrene, Vinylbenzene, Phenylethylene.

4.1.3 *Chemical Formula:* C_8H_8.

4.1.4 *Structural Formula:* $C_6H_5CH{=}CH_2$



4.1.5 *CAS Registry No.:* 100-42.5

4.1.6 *UN Designation:* 2055

4.1.7 *Molecular Weight:* 104.14

4.2 Physical Properties

4.2.1 *Description, Colour, Odour, Physical State*

Styrene is a colourless liquid with sweet smell in low concentrations (odour threshold 0.148 ppm) increasingly disagreeable smell in higher concentrations. It is a liquid at room temperature.

4.2.2 *Boiling Point (at 1 atm):* 145.2°C

4.2.3 *Melting Point:* 31°C

4.2.4 *Specific Gravity (25/25°C):* 0.9045

4.2.5 *Vapour Pressure (25°C):* 6.2 mm mercury

4.2.6 *Miscibility (Solubility in Common Solvents)*

It is soluble in ethanol, diethylether and acetone, very soluble in benzene and petroleum ether. It is very sparingly soluble in water.

4.2.7 *Vapour density:* 3.6 (Air = 1.0).

4.2.8 *Critical Properties*

P_c : 3.81 MPa
T_c : 369°C

4.2.9 *Refractive Index:* 1.546 8

4.3 Chemical Properties

4.3.1 *Reactivity*

Styrene is very reactive. Its rate of polymerisation rapidly increases in admixture with many of the common reagents and at elevated temperatures. It also reacts with sulphuric acid and metal chloride with violence. Unless adequately inhibited with polymerisation inhibitor (for example, *p*-tertiary butyl catechol in 15 to 75 ppm concentration), long storage in tanks and drums is not recommended.

4.3.2 *Stability at High Temperature*

Styrene polymerises rapidly if kept at temperature above 85 - 90°C even in presence of an inhibitor.

4.3.3 *Light Sensitivity*

It oxidizes slowly on exposure to light and air and turns yellowish in colour.

4.3.4 *Flammability*

Lower flammable limit in air is 1.1 percent by volume and upper flammable limit in air is 6.1 percent by volume. It is classified as flammable.

4.3.5 *Heat of Polymerisation:* 154 cal/g.

4.4 Fire and Explosion Hazard Properties

4.4.1 *Flash Point (Closed cup):* 31°C.

4.4.2 *Explosive Range*

(Percent by volume in air at °C)	LEL — 1.1 UEL — 6.1

4.4.3 *Auto-ignition, Temperature* 490°C.

4.4.4 *Behaviour in Fire*

Vapour is heavier than air and may travel considerable distance to a source of ignition and flash back. At elevated temperature such as in fire condition, polymerisation may take place, which may lead to container explosion.

4.5 Corrosion Properties

Non-corrosive to most metals except copper and copper -containing alloys.

5 HEALTH EFFECTS AND TOXICITY INFORMATION

5.1 General

5.1.1 *TLV (8 hours TWA):* 50 ppm (210 mg/m^3) ACGIH

5.1.2 *STEL(15Mts):* 100 ppm (420 mg/m^3) ACGIH

5.1.3 *IDLH:* 5 000 ppm (21 000 mg/m^3)

5.1.4 *TDL (ORAL - Rat) LD_{50}:* 4 920 mg/kg.

5.2 Route of Entry

Inhalation, absorption through skin and ingestion.

5.3 Exposure Concentration, Duration and Health Effects

The toxicity of styrene monomer when considered as an industrial chemical is low. It is a moderate irritant to the eyes and respiratory tract in concentrations above 400 ppm. Vapour concentrations three times as great, are extremely irritating to the eyes and nose. Concentrations of 10 000 ppm are acutely dangerous, causing lung irritation and central nervous system depression and may be fatal in 30 to 60 minutes. Prolonged exposure to styrene concentration of less than 50 mg/m^3 caused disorders of certain lever function. It is advisable to limit the employment of women in organic synthesis plants where styrene is used as raw material. Expectant mother and women with ovulation and menstrual disorders should not be admitted to work exposing them to styrene compounds.

5.3.1 *Eyes*

Both liquid and concentrated vapours are extremely irritating, leading to inflammation of the eyes. Styrene vapours contaminated with chlorine can have a powerful lachrymatory effect.

5.3.2 *Ingestion*

When taken by mouth, styrene monomer causes a pronounced irritation of the mouth, esophagus and acute stomach pain.

5.3.3 *Skin Contact*

Skin contact causes irritation, longer exposure results in redness of skin and blisters. Repeated skin contact can lead to dermatitis due to defatting action on the skin. Exposure to styrene vapours may also give rise to skin irritation.

6 PERSONAL PROTECTIVE EQUIPMENT

Protective equipments should include safety helmet, gas masks and self-contained or supplied air breathing apparatus, gloves and aprons of neoprene rubber to avoid contact with liquid. Safety goggles, face shields, chemically resistant PVC sole shoes should be used to prevent splashing of the liquid into any part of the body. Barrier creams are valuable adjunct.

7 STORAGE, HANDLING, LABELLING AND TRANSPORTATION

7.1 Storage

Store styrene in containers in cool well ventilated area, away from heat, sparks, flame, oxidising materials, catalyst for vinyl polymers, peroxides, strong acids, and aluminium trichloride. The storage tank located above the ground level should be provided with a sprinkler arrangement which should be operated when the tank temperature rises. Styrene in storage should have 5 to 100 ppm inhibitor depending on period of storage. Styrene can be safely stored in vented steel or aluminium bulk storage tanks or in mild steel or galvanised iron drums with internal epoxy coating and external heat reflecting paint. Amber coloured glass containers are particularly suitable for storing in small quantities in refrigerators or cold boxes. Styrene should not be stored in vessels made of copper or copper containing alloys as styrene monomer is known to attack copper forming copper compounds which exert an inhibition action on the polymerisation reaction. The contents of the containers or tanks should be periodically stirred or circulated to avoid localised overheating of stagnant material. The monomer must be checked at least weekly to determine inhibitor and polymer content if the period of storage is more than a week (*see* IS 4105 for analytical procedures). Storage tanks should be free of internal supports and should be periodically checked for polymer deposits obstructing the nozzles. Storage tanks may be provided with nitrogen blanketing facility to avoid contact with air.

7.2 Handling

7.2.1 *Drum Handling*

Drums should be handled carefully during loading and unloading to prevent damage. Each shipment should be examined for leaking drums, which should be removed to a safe place where the leakage can be stopped or the contents transferred to a sound container. Before emptying, the drum should be supported and blocked to prevent movement and the drum should be electrically bonded to the ground. Suitable protective personal equipment should be worn when removing styrene monomer from drums. Styrene can be removed from the drums by gravity by inserting a faucet in the end bung of the drum, or by means of a rotary pump with a flexible metal hose.

7.2.2 *Road Tankers*

While unloading road tankers, the engines should be stopped and not started again during the entire operation. Truck breakers should be set and the wheel blocked. The tank truck should be effectively electrically grounded to prevent the formation of static sparks. All containers to be filled from the tank truck should be electrically connected and grounded to the truck chasis before filling operation is started. Do not use rubber type flexible hose in unloading/loading styrene. Use stainless steel flexible lose.

7.3 Labelling

Use of hazard warning notices in plant area and labels on containers are recommended.

7.3.1 Cautionary and warning notice to be displayed include:

NO SMOKING
NO NAKED FLAME
USE PERSONAL PROTECTIVE EQUIPMENT
WORK PERMIT REQUIRED
USE RIGHT TYPE OF EXTINGUISHER

7.3.2 Information on labels on containers includes:

STYRENE

DANGER — FLAMMABLE AND REACTIVE; KEEP AWAY FROM FLAME AND HEAT

DANGER — HIGHLY IRRITATING: AVOID INHALATION AND SKIN CONTACT

7.4 Transport

7.4.1 Road tankers should comply with the Rules and Regulations laid down in the *Petroleum Act* and *Rules* thereunder.

7.4.2 Transportation of styrene by road or rail should comply with the SMPV rules and regulation applicable to carrying of hazardous chemicals.

7.4.3 Drums and containers must have an identification label with name 'Styrene Monomer' along with the 'Flammable' sign as per IS 1260 (Part 1).

7.4.4 Do not use rubber, plastic or teflon type flexible hose in handling styrene. Stainless steel flexible hose should be used.

8 SPILLAGE/LEAKAGE AND WASTE DISPOSAL

8.1 Spillage/Leakage

8.1.1 All spills and leaks should be immediately washed out with water into process sewers.

8.1.2 If water is not available, styrene monomer may be absorbed by dry earth or sand and then taken out in a container to a disposal area.

8.1.3 During heavy leakages, shut off all flows and sources of ignition. If necessary, the plant should be shut down. Only authorised persons provided with suitable personal protective equipment should remain in the area.

8.1.4 Use of non-sparking tools is recommended.

8.1.5 Leaking tankers of containers should be promptly attended. Such tankers or containers should be removed to a safe place away from human habitation and the area cordoned off. Only properly protected personnel should be allowed to enter the area.

8.1.6 Clothing or shoes saturated with styrene monomer should be removed promptly and the body washed thoroughly with plenty of water.

8.2 Waste Disposal

All relevant regulations of local and state authorities for prevention and control of pollution should be observed.

8.2.1 Water contaminated by styrene monomer should be removed to a safe location and styrene layer separated. Water can be disposed of after suitable treatment such as charcoal absorption aeration, etc.

8.2.2 All waste material contaminated with styrene monomer should be disposed of by safe burning.

8.2.3 In case of a major spill or a equipment rupture, only properly protected personnel should remain in the area.

8.2.4 Atomization and burning in a furnace properly designed for the job can be adopted. Incineration will become easier by mixing with a relatively more flammable solvent.

9 FIRE PREVENTION AND FIRE FIGHTING

9.1 Fire Prevention

Styrene monomer is flammable and forms explosive mixtures with air. However, it is only moderately flammable by virtue of its relatively high flash point. Smoking should be prohibited. Open flames, local hot spots, friction, static electricity and other sources of ignition should be avoided in storage and handling of this material. Adequate ventilation should be provided in enclosed spaces. Equipment and pipelines should be grounded to avoid accumulation of static charge.

9.2 Fire Fighting

In case containers or tanks are exposed to fire, keep them cool with water spray. In case of massive fire, carry out fire fighting operation from safe distance or protected location. Use dry chemical powder, foam, or carbon dioxide. Water may be ineffective on fire. If a leak or spill has not ignited, use water spray to disperse the vapours. If it is necessary to stop a leak, use water spray to protect men attempting to do so. Water spray may be used to flush spills away from exposures. Styrene monomer vapours are uninhibited and may form polymers in vents or flame arrestors of storage tanks, resulting in stoppage of vents. Fire fighting personnel should wear self contained breathing apparatus to avoid inhaling styrene vapours during fire fighting.

10 TRAINING AND HEALTH MONITORING

10.1 Training

10.1.1 Employee education, training and proper supervision are recognised as fundamental precautionary measures. Unauthorized and untrained employees should not be permitted in areas where styrene monomer is handled.

10.1.2 Workers should be thoroughly informed about the hazards arising from improper handling of styrene monomer. They should be trained to take proper action in case of spills, leaks, splashes, vapour inhalation or clothing contamination.

10.1.3 Instructions on safety procedures and precautions should be framed by competent person to avoid spillages, splashing, leaks, inhalation of the vapour or ingestion and these should be vigorously adopted and implemented.

10.1.4 Before being placed on the job, new employees should be instructed thoroughly in proper handling of styrene monomer. Older employees should be re-educated periodically.

10.1.5 Each employee should know the purpose and care of personal protective equipment and be thoroughly trained in proper usage of the same.

10.1.6 Each employee should know the location and operation of fire alarm systems, sprinklers, monitors, hydrants and other fire fighting equipment. They should know the location of safety showers, eye washes and first-aid boxes.

10.2 Health Monitoring

10.2.1 *Replacement Physical Examination*

Asthmatic individuals and those suffering from chronic pulmonary infection should not be employed in operations and where they might come in repeated contact with styrene monomer.

10.3 Air Monitoring of the Work Place

Periodical air monitoring should be carried out to assess the exposure risk and necessary control measures should be implemented to maintain the ambient concentration of styrene below the TLV.

11 FIRST AID

11.1 Inhalation

If affected by inhalation of vapours, remove the victim to fresh air. Give prompt medical attention and artificial respiration. If needed.

11.2 Skin Contact

In case of skin contact, wash the affected part with plenty of water. Soaked clothes should be removed immediately. If irritation persists, get medical help.

11.3 Eye Contact

In case of eye contact, wash the eyes for 15 min in running water. For sore eyes and inflammation get medical help immediately.

11.4 Ingestion

If taken orally, induce vomiting. If unconscious, lay patient with head at low position. Call a physician.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

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	Representing
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DR P. N. VISWANATHAN	Industrial Toxicology Research Centre, Lucknow
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Member Secretary

SHRI N. K. PAL
Joint Director (Chem), BIS

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(*Continued on page* 6)

(*Continued from page 5*)

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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